PRO-LOG CORPORATION

7706

**Battery Backed
Byte-Wide RAM Card**

USER'S MANUAL

STD BUS

NOTICE

PRO-LOG CORPORATION

7706

**Battery Backed
Byte-Wide RAM Card**

USER'S MANUAL

8/82

FOREWORD

This manual explains how to use Pro-Log's 7706 Battery Backed Byte-Wide RAM Card. It is structured to reflect the answers to basic questions that you, the user, might ask yourself about the 7706. We welcome your suggestions on how we can improve our instructions.

The 7706 is part of Pro-Log's Series 7000 STD BUS hardware. Our products are modular, and they are designed and built with second-sourced parts that are industry standards. They provide the industrial manager with the means of utilizing his own people to control the design, production, and maintenance of the company's products that use STD BUS hardware.

Pro-Log supports its products with thorough and complete documentation. Also, to provide maximum assistance to the user, we teach courses on how to design with, and to use, microprocessors and the STD BUS products.

You may find the following Pro-Log documents useful in your work: Microprocessor User's Guide and Series 7000 STD BUS Technical Manual. If you would like a copy of these documents, please submit your request on your company letterhead.

Contents

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SECTION 1
Purpose and Main Features

The 7706 Battery Backed Byte-Wide RAM card provides 2,4,8, or 16K of nonvolatile RAM with guaranteed data retention time of two years, typical five years. For truly non-volatile operation a voltage monitoring circuit senses when power is below normal and protects the RAM from spurious writes as power goes down, or comes up.

The 7706 also serves as a flexible general purpose memory card. It can be mapped to any 16K quadrant and its size can be tailored to 2K increments. It responds to the STD BUS memory expansion line (MEMEX) for two 64K memory banks, and an external Segment Select line for multiple 64K memory banks. It has four write inhibit switches which, when enabled, allow the memory to be used as ROM.

Simplicity of design and popular, high speed, byte-wide RAMs are used for optimum cost effectiveness, reliability, and high speed operation.

FEATURES

- Operates with high speed processors such as the 4 MHz 780A
- Uses one ½" card slot
- 2,4,8, and 16K byte versions
- 2 years guaranteed data retention, 5 years typical
- Can be mapped to any 16K quadrant
- No wasted memory space—unused memory parts can be disabled
- Write inhibit switches for data protection
- Processor independent—use with 8085, Z80A, 6800/09, and others
- Single +5V supply
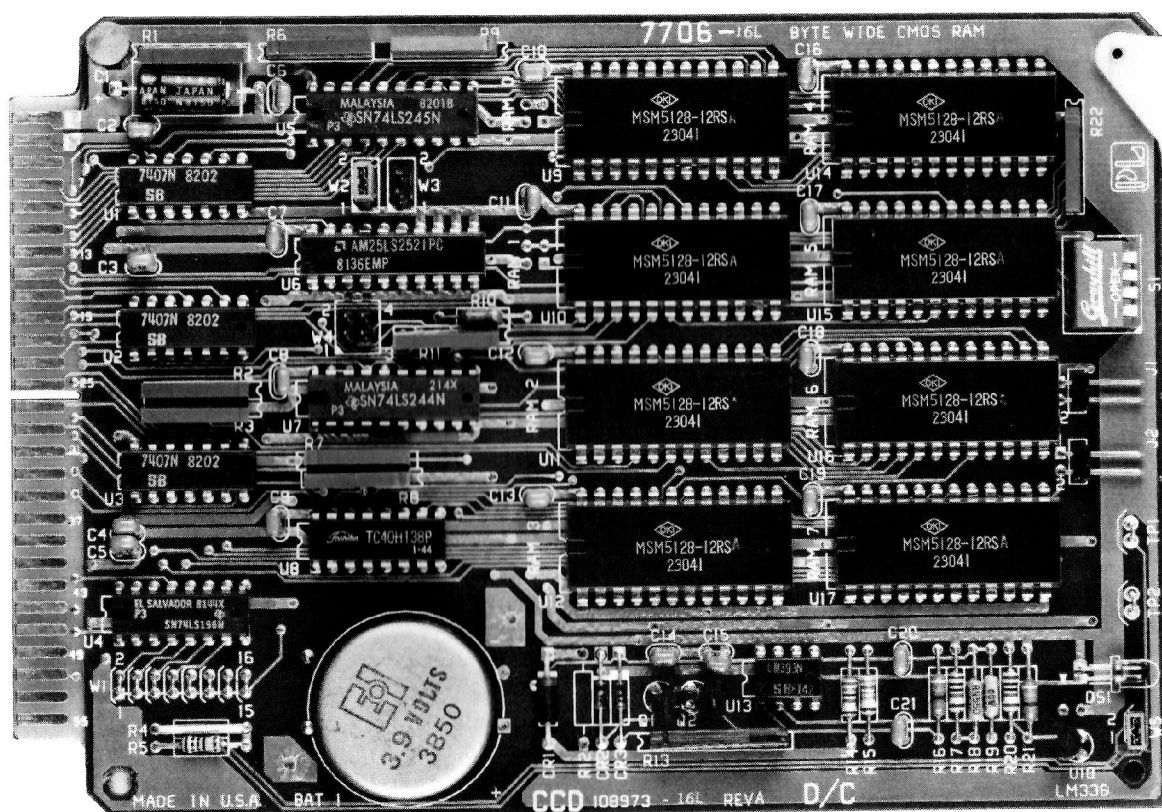
Figure 1-1. 7706 Battery Backed Byte-Wide RAM Card
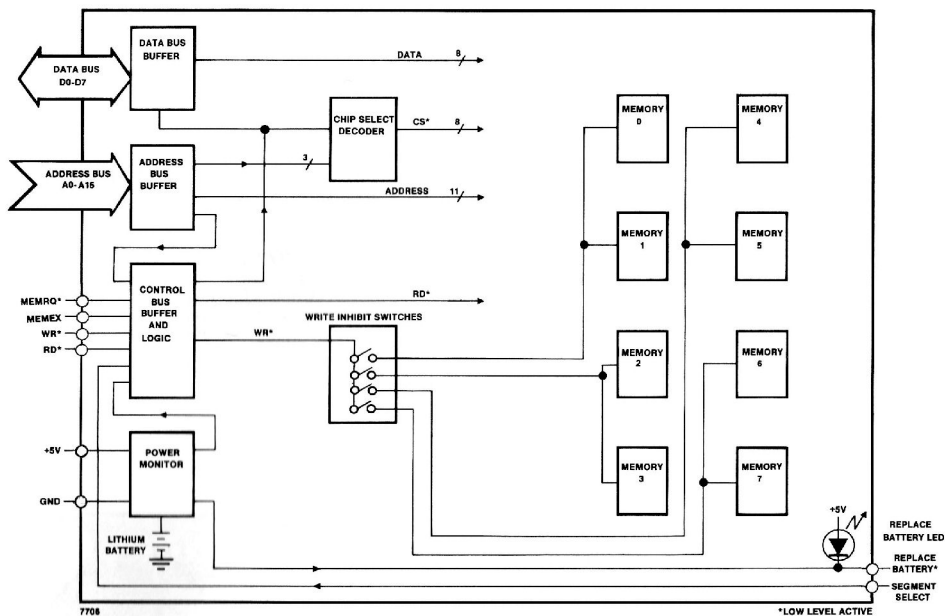
Figure 1-2. 7706 Block Diagram

SECTION 2
Installation and Specifications

INTRODUCTION

This section reviews the optional functions of the 7706, how to install the 7706, and gives specifications at the end of this section.

INSTALLATION

The 7706 Battery Backed Byte-Wide RAM card functions as a part of an STD BUS system. It can be plugged into any slot in an STD BUS card cage. The white ejector tab must be at the top of the card cage (see Fig. 2-1). If access to the card is needed, an extender card, such as Pro-Log's 7901 card, can be plugged into the card cage and the 7706 plugged into the extender card. Procedures for installing and removing the card with data retention are given in Section 3 of this manual under the "Powering Up and Down with Data Retention" heading.

Caution

Always be sure power is off before inserting or removing the 7706.
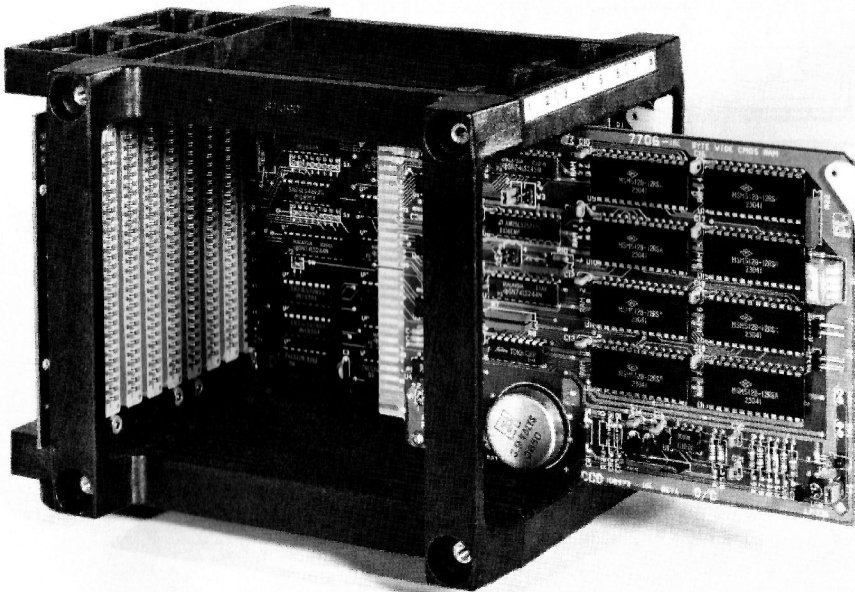
Figure 2-1. 7706 Installation

SEGMENT SELECT AND REPLACE BATTERY* CONNECTIONS

Two signals are accessible at the front edge of the card. One is Segment Select, for multiple memory banks, and the other is Replace Battery*, to indicate when the battery is low. The location of these connectors is shown in Fig. 2-2. They are two-pin connectors, having 0.025" pins on 0.1" centers. Each connector has a signal and a ground line. A twisted pair cable, such as Pro-Log's RC704 cable, should be used for connection to other cards.

The Segment Select signal can be driven by a TTL output line, such as that provided on Pro-Log's 7605 card, or any spare TTL output lines available in your system (see Fig. 2-3). The Replace Battery* signal may be connected to an input line, such as that provided on the 7605, or to a priority interrupt controller, such as Pro-Log's 7320 card. Pro-Log's 7801 processor card has interrupt inputs, and the 7804 processor card has a TTL input to which the Replace Battery* signal may be connected (refer to Fig. 2-4).
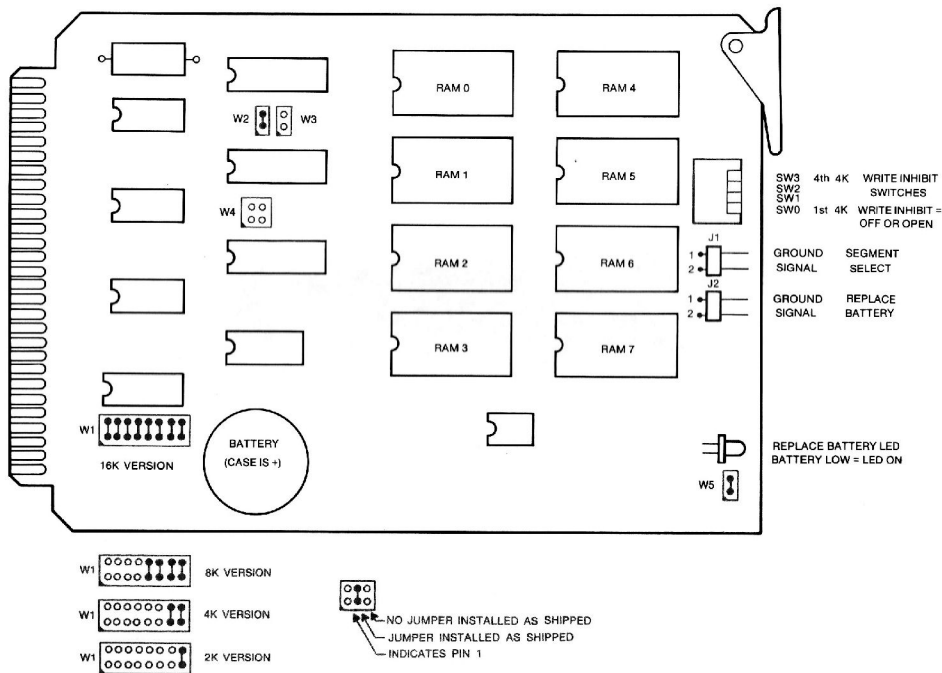
Figure 2-2. 7706 Location of Main Features
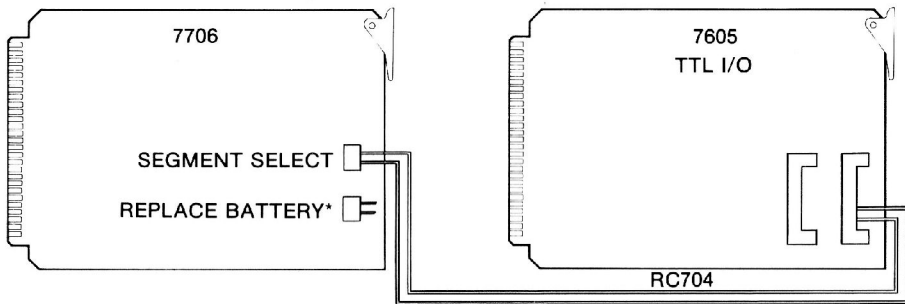
Figure 2-3. 7706 Segment Select Connection
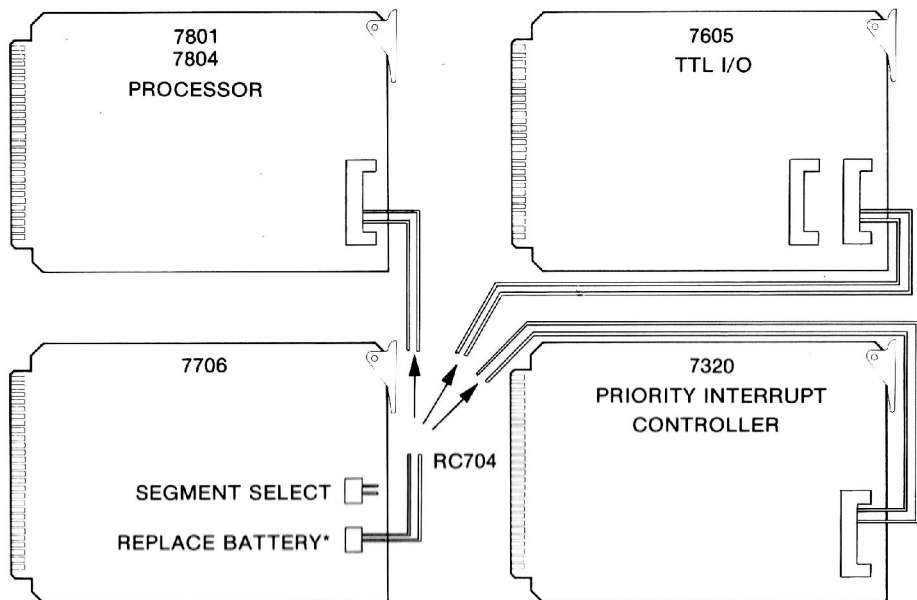
Figure 2-4. 7706 Replace Battery* Connection

JUMPER OPTIONS

The 7706 has several optional functions which are selectable by wire jumpers or wirewrap posts. The wirewrap posts can be connected by wirewrap or shorting plugs. Figure 2-5 shows the locations and functions of these jumpers and posts.

Jumpers W2, W3, W4, and W5 are wirewrap posts. Jumpers W2 and W5 come with shorting plugs of the type listed under the "Connector" heading of Fig. 2-6. This type of connector is short enough to allow the card to occupy one ½" card slot.

The jumpers in jumper block W1 are soldered in wire jumpers. The number of jumpers installed in the jumper block depends on the amount of memory supplied on the version of the 7706 you may have. These jumpers can be disconnected simply by cutting them. Be sure to cut them in two places to prevent them from reshorting. To replace a jumper, cut in half and remove one half at a time. Remove any excess solder and install new jumpers as needed. Be sure the nonconductive protective backing is replaced. Spare pads can be ordered from Pro-Log under Part number 107100.

If there is a need to frequently change these jumpers (e.g. in prototyping), you may want to replace these wire jumpers with wirewrap posts, like those used for the other jumpers. Figure 2-6 provides a list of parts numbers for both the wirewrap posts and the shorting plug.

JUMPER	DESCRIPTION	COMMENTS
W1	Chip Disables	Remove jumper to disable part 15-16 = RAM 0; 1-2 = RAM 7.
W2	Memex Polarity	Jumper installed = MEMEX low-level active
W3	Segment Select Polarity	Jumper Installed = Segment Select Low-Level Active
W4	Memory Mapping	Selects one of four 16K Quadrants, see Pg. 2-6.
W5	Battery Enable	Jumper installed engages battery.
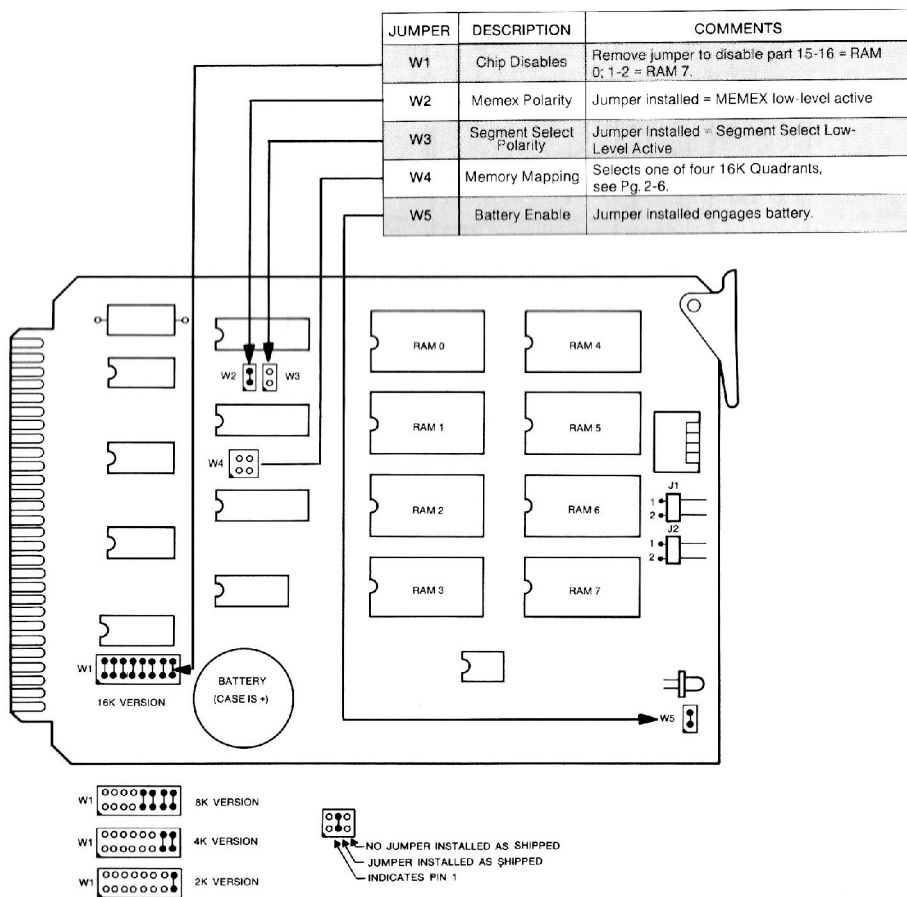
Figure 2-5. 7706 Jumper Locations and Functions

PART	MANUFACTURER PART NUMBER	
	ELCO CORP.	BERG ELECTRONICS
2-PIN HEADER	00 8261 02 32 00 852	65611-102
4-PIN HEADER	00 8261 04 32 00 852	65611-104
6-PIN HEADER	00 8261 06 32 00 852	65611-106
8-PIN HEADER	00 8261 08 32 00 852	65611-108
CONNECTOR	00 8261 02 42 00 870	

Figure 2-6. Replacements for Wire Jumpers

BATTERY BACK-UP

The battery back-up circuit on the 7706 will retain data for at least two years, typically five years. This is true for both fully and partially populated versions. Neither using a partially populated card, nor keeping power applied to the card as much as possible will make a significant difference in battery life.

Jumper W5 completes the battery back-up circuit. The card is shipped with the jumper installed. It should be left installed except to replace the battery or for repair. Frequent removing and installing of the jumper can shorten battery life because of the current surge which occurs when the battery is engaged.

RAM 0 0000	RAM 4 2000
RAM 1 0800	RAM 5 2800
RAM 2 1000	RAM 6 3000
RAM 3 1800	RAM 7 3800
	3FFF

W4

OPTION 0

RAM 0 4000	RAM 4 6000
RAM 1 4800	RAM 5 6800
RAM 2 5000	RAM 6 7000
RAM 3 5800	RAM 7 7800
	7FFF

W4

OPTION 1

RAM 0 8000	RAM 4 A000
RAM 1 8800	RAM 5 A800
RAM 2 9000	RAM 6 B000
RAM 3 9800	RAM 7 B800
	BFFF

W4

OPTION 2

RAM 0 C000	RAM 4 E000
RAM 1 C800	RAM 5 E800
RAM 2 D000	RAM 6 F000
RAM 3 D800	RAM 7 F800
	FFFF

W4

OPTION 3
(AS SHIPPED)

2 4

◀ JUMPER INSTALLED
NO JUMPER INSTALLED
INDICATES PIN 1

1 3

Figure 2-7. 7706 Memory Mapping Options

Tailoring Memory Size

The 7706 comes in four versions, 2, 4, 8, and 16K. Its size can be tailored in 2K increments by disabling any unused memory parts. For example, a 12K card can be configured by using a 16K card and disabling two of the RAMs. When a RAM is disabled, the memory space that it had occupied becomes available to other cards in the system. Any number and combination of RAMs can be disabled.

Disabling is performed by cutting one or more jumpers in jumper block W1. Figure 2-8 shows the location of W1 and indicates which jumper affects each RAM. Be sure to cut the jumper in two places to prevent it from reshorting. This feature can also add to the memory mapping flexibility. Refer to the "Memory Addressing" section. The address of each socket is shown in Figure 2-7.

MEMORY MAPPING

Memory Address

The 7706 has four memory mapping options. Figure 2-7 shows the four options, the address that each memory part occupies, and how jumper W4 should be configured to select each option. Each option maps the card to a different 16K quadrant of a 64K memory system. The card comes from the factory mapped to the last quadrant, address C000. The four optional starting addresses are:

0000
4000
8000
C000

The other versions of the 7706 have fewer memory parts installed. The memory parts used are:

2K version has RAM 0
4K version has RAMs 0 and 1
8K version has RAMs 0, 1, 2, and 3

Like the 16K version, these versions have only the four mapping options already mentioned. Therefore, an 8K card can be mapped, for instance, at C000-DFFF, but not E000-FFFF.

If an 8K card mapped at E000-FFFF is needed, it is possible to configure one by using a 16K card and disabling the lower 8K. Using this method, any amount of RAM can be located at any part of the 16K quadrant in which the 7706 is mapped. Note that a card cannot be mapped to straddle a 16K boundary, such as B000-CFFF.

> **Caution**
>
> Users should not install additional memory parts in boards that are only partially populated. The memory parts Pro-Log uses are selected for low power consumption and severely tested, guaranteeing at least two years data retention. Other sources of functionally compatible CMOS RAMs have been found to draw up to 100 times as much current. Such current drains would shorten battery life severely, making it impossible to determine when the battery will fail. If memory parts are added by the customer, Pro-Log will consider the warranty on battery life to be void.
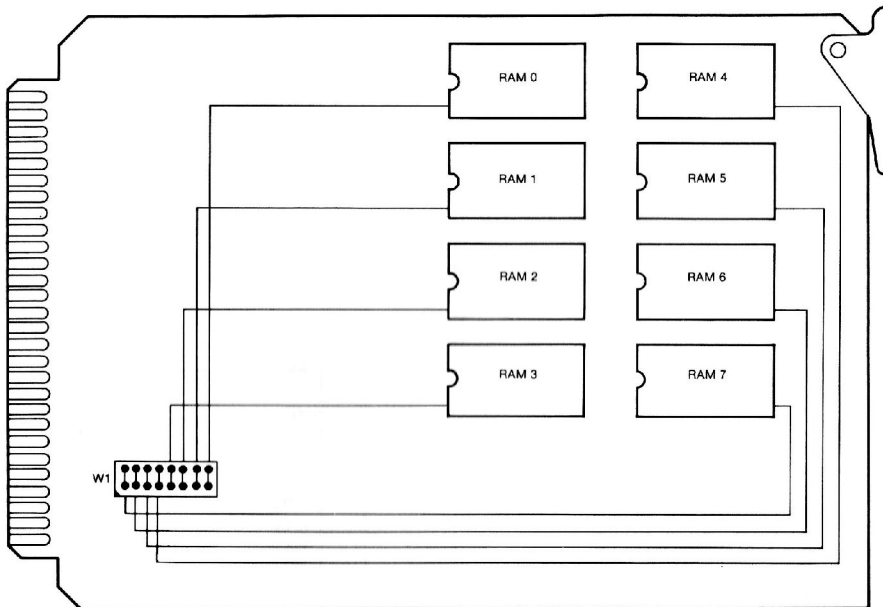

Figure 2-8. 7706 Chip Disable Jumpers

ELECTRICAL SPECIFICATIONS

Figures 2-9, 2-10, and 2-11 give electrical and environmental specifications for the 7706.

MNEM.	PARAMETER	Recommended Operating Limits			Absolute Non-Operating Limits		
		MIN	TYP	MAX	MIN	MAX	UNITS
—	Free Air Temperature	0	+25	+55	-40	+75	°C
—	Humidity	5		95[1]	5	95[1]	%RM
Vcc	Logic supply	4.75	5.00	5.25	0	5.50	Volts

[1] Non condensing

Figure 2-9. 7706 Electrical and Environmental Specifications

MNEM.	PARAMETER	Recommended Operating Limits			
		MIN	TYP	MAX	UNITS
Icc	Vcc Supply Current		145	280	mA

Figure 2-10. 7706 Electrical Characteristics

OUTPUT (LSTTL DRIVE) INPUT (LSTTL LOADS) MNEMONIC			PIN NUMBER	PIN NUMBER			OUTPUT (LSTTL DRIVE) INPUT (LSTTL LOADS) MNEMONIC
+5 VOLTS	VCC		2	1		VCC	+5 VOLTS
GROUND	GND		4	3		GND	GROUND
-5V			6	5			-5V
D7	1	55	8	7	55	1	D3
D6	1	55	10	9	55	1	D2
D5	1	55	12	11	55	1	D1
D4	1	55	14	13	55	1	D0
A15	1		16	15		1	A7
A14	1		18	17		1	A6
A13	1		20	19		1	A5
A12	1		22	21		1	A4
A11	1		24	23		1	A3
A10	1		26	25		1	A2
A9	1		28	27		1	A1
A8	1		30	29		1	A0
RD*	1		32	31		1	WR*
MEMRQ*	1		34	33			IORQ*
MEMEX	1		36	35			IOEXP
MCSYNC*			38	37			REFRESH*
STATUS 0*			40	39			STATUS 1*
BUSRQ*			42	41			BUSAK*
INTRQ*			44	43			INTAK*
NMIRQ*			46	45			WAITRQ*
PBRESET*			48	47			SYSRESET*
CNTRL*			50	49			CLOCK*
PCI	IN		52	51	OUT		PCO
AUX GND			54	53			AUX GND
AUX -V			56	55			AUX +V

* Designates active low-level logic

Figure 2-11. STD/7706 Edge Connector Pin List

INTRODUCTION

This section explains the operation and use of the 7706 card.

WRITE INHIBIT SWITCHES

There are four Write Inhibit switches. Figure 3-1 shows their location and which memory parts are affected by each switch. Each switch protects one 4K block of memory. To inhibit writing, the switches should be in the "OFF" or "OPEN" position.

With the write line inhibited, the memory functions as ROM. These switches should be used when inserting or removing the card with data retention.
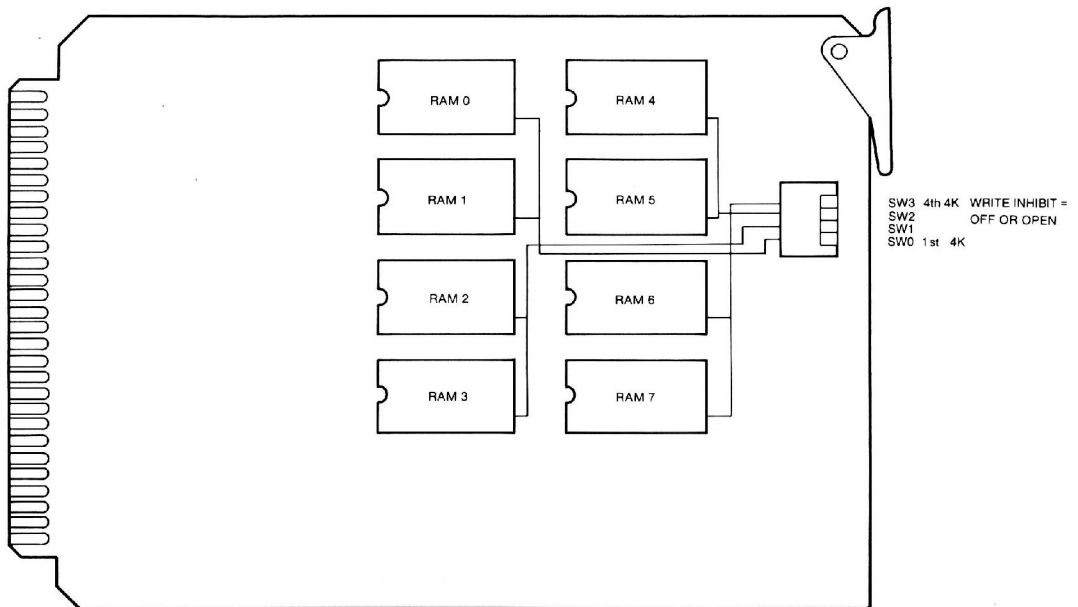

RAM 0   RAM 4

RAM 1   RAM 5

RAM 2   RAM 6

RAM 3   RAM 7

SW3 4th 4K WRITE INHIBIT =
SW2   OFF OR OPEN
SW1
SW0 1st 4K

Figure 3-1. 7706 Write Inhibit Switches

POWERING DOWN AND UP WITH DATA RETENTION

Normal Power Cycling

Figure 3-2 gives flowcharts for turning power off and on, and for removing and inserting the 7706 with data retention. The flowcharts involve some software and some manual operations. The flowcharts incorporate the following three guidelines, which must be followed when power cycling with data retention:
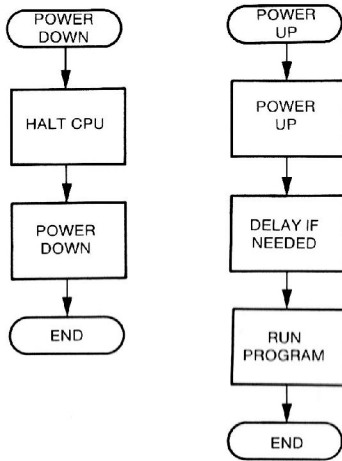

Figure 3-2A. Power Cycling Procedures

● **Prevent the processor from writing to the 7706.** Any data being written to the processor at the time it write-protects itself may not get written correctly. If in your application you need to avoid this possibility, the processor should be halted. This can be done by a HALT instruction or by inhibiting the processor through hardware, as by activating the WAITRQ* line.

Also, you should not attempt to write to the 7706 immediately after power-up. The 7706 write protects itself whenever power is below normal. It is possible for the processor to be active before the 7706 is ready to accept data. If this is a possibility in your program, the problem can be avoided by putting a short delay at the beginning of your program. The required length of the delay is dependent on the rise time of your power supply.

● **Use the Write Inhibit switches when removing the card.** When removing or inserting the card, put the Write Inhibit switches in the "OFF" or "OPEN" position.

● **Never insert the card with power on.** When inserting or removing the 7706, or any card, be sure the power is off.
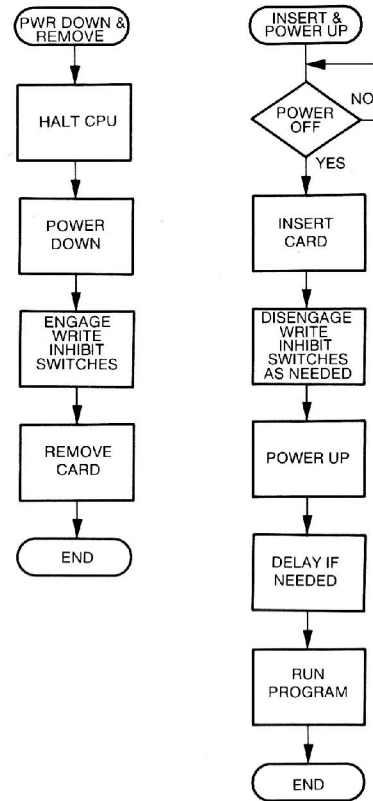

Figure 3-2B. Power Cycling Procedures

Data Retention During Power Failures

Figure 3-3 shows the procedure for retaining data during a power failure. The procedure will also retain the address that is in the program counter when power goes down. It assumes that there is power failure detection circuitry in the system (see Fig. 3-4). While the detection circuitry is not essential, since the 7706 will retain data through a power failure, it does have three advantages:

First, the processor will know in advance that power is going down. This gives it a chance to move essential data and the subroutine stack onto the 7706. Even if these are normally kept on the 7706, you may also need to store the contents of the registers.

Second, a flag can be set to indicate to the processor, when it comes back up, that it has been through a power failure. This flag would be stored in a memory location on the 7706. To use this flag, when normally powering down, you would indicate to the system that you were powering it down and it would not set the flag. The indication would be given through some input such as a keypad (if there is one), or a pushbutton connected to a spare input line. When there is no such indication, as in an unexpected power failure, the processor sets the flag. When the processor comes back up, it can check the flag to know whether this is a normal power-up or whether it has just experienced a power failure.

Third, the same circuitry can be used to halt the processor. This ensures that the processor is not writing to the 7706 when it write-protects itself. Data written at this time may not get written correctly.

The ability to halt the processor requires the detection circuitry to have two trip points: one to forewarn the processor, the other to halt the processor, by lowering the WAITRQ* line for example. Or, alternatively, the processor can perform a HALT instruction when it is through moving data onto the 7706.
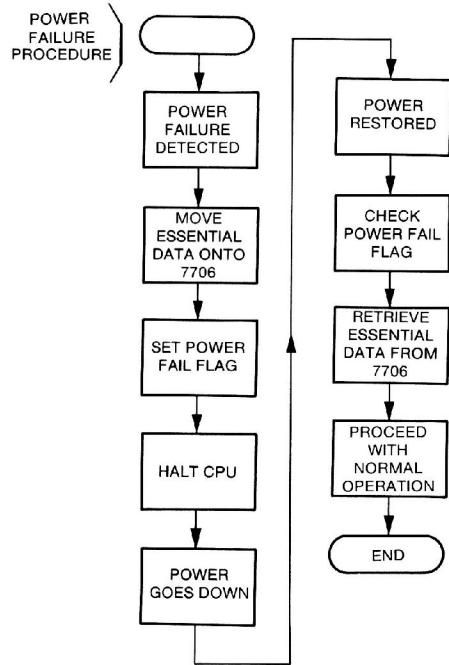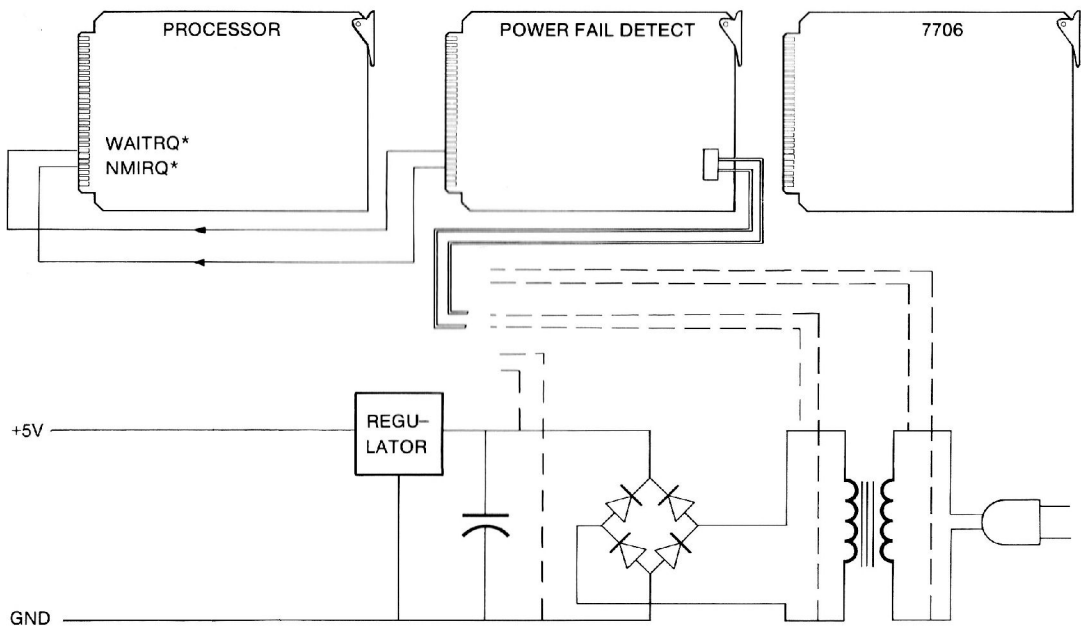

Figure 3-3. 7706 Power Failure Procedure

Figure 3-4. 7706 Detection Circuitry Example

REPLACE BATTERY* SIGNAL AND LED

The 7706 has onboard circuitry to monitor the battery voltage. It indicates when the battery life is down to approximately two weeks. It does this in two ways: When Vcc is on, an LED at the front edge of the card turns on, and the Replace Battery* signal activates. This signal is accessible at a two-pin connector on the front edge of the card. The location of the LED and connector is shown in Fig. 2-2. Figure 2-4 shows how the signal can be connected. It can be input through an input port, in which case the processor will have to scan the input from time to time, or it can be connected to an interrupt input. If an input port is used, any spare input line in the system can be used. Pro-Log's 7804 Z80A processor card has an input line onboard which can be used. If an interrupt input is used, a priority interrupt controller can be used, such as Pro-Log's 7320 card, or an interrupt input on the processor card can be used. Pro-Log's 7801 processor card has interrupt inputs available on the card. Instructions for replacing the battery are given in Section 5 of this manual.

MEMEX

MEMEX is an STD BUS signal. It is usually controlled by a memory segment controller or an output port. Most Pro-Log processor cards have the ability to control MEMEX. Its function is to allow two banks of memory, up to 64K each, to reside in one system. One bank is enabled when MEMEX is high, and the other when it is low. It is useful for expanding memory beyond 64K, and in bootstrapping. In bootstrapping, the MEMEX line is used to enable the bootstrap PROM at power-up and switch to a block of RAM after bootstrapping is completed.

Figure 3-5 shows an example of how MEMEX can be used in a typical system. The system controls a robot arm working on an assembly line. It has sensors to input data concerning the equipment to be worked on. The data gathered from the analog sensors is temporarily stored in the system. Calculations are then performed on it and instructions are output to the robot arm.

The main memory of the system consists of 56K of ROM and 8K of RAM. This is divided between the processor card and the 7704 memory card. The 8K of RAM is used for manipulating data, scratchpad RAM, and for the subroutine stack. More RAM is therefore needed to store data as it is received, until it is used. A second bank of memory is used for this purpose and the 7706 resides in this bank.

The 7706 resides in the same address space the 7704 occupies. Only one card is enabled at a time, however. The processor has an onboard I/O port used to drive the MEMEX line. By setting the MEMEX line either high or low, the processor can choose which card is enabled. The memory onboard the processor card itself is permanently enabled, that is, it ignores MEMEX.

The processor can enable the 7706 when it is receiving data and store the data there. It can then move the data in blocks, through the RAM on the processor card, to the 7704. There it can perform calculations on the data. By manipulating the MEMEX line the processor can choose which bank of memory it is working with at any time.
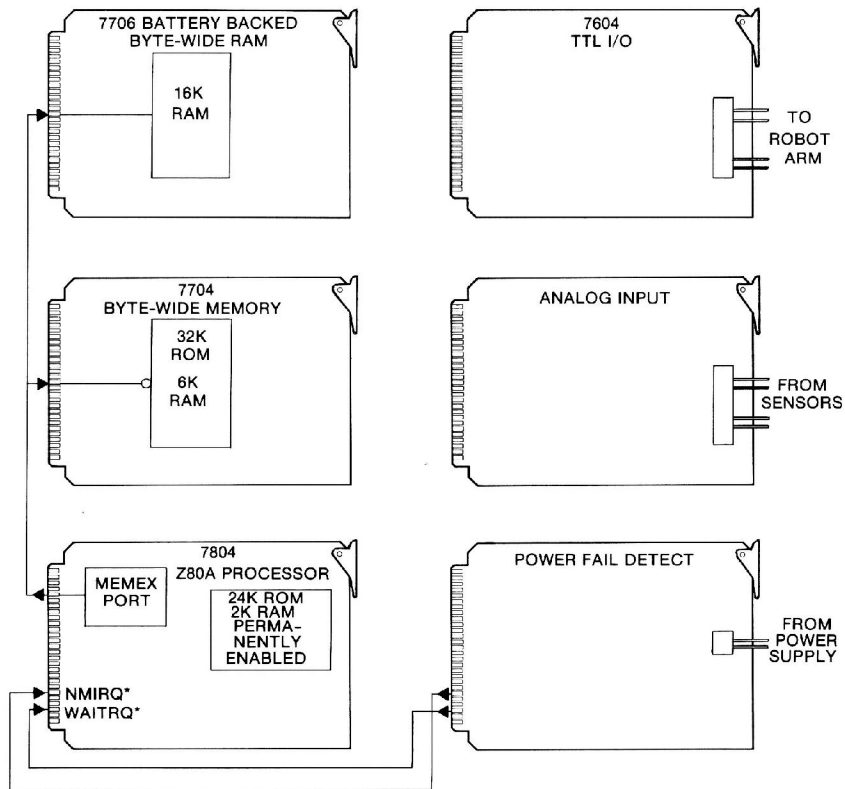
Figure 3-5. 7706 MEMEX Example

SEGMENT SELECT

Segment Select is an external signal which selects one out of any number of memory banks. MEMEX allows only two banks. Segment Select can be controlled by a memory segment controller or by output ports. One output port can control eight segments. A segment can be made up of one or more cards.

Figure 3-6 is an example of how Segment Select can be used. The system inputs data from a number of remote stations via a modem. It collects data throughout the evening, de-cyphers it, and organizes it. In the morning the information is passed on to the host system.

The processor card has 32K of memory onboard which is permanently enabled. The data is received through the dual UART card. It is stored in two 32K segments, each segment consists of two 16K 7706 cards. A third segment consists of 32K of RAM on the 7704 card and is used as data manipulation space. A 7605 card is used to select the segments.

The 7704 is enabled with its Segment Select line low. The two segments of 7706s are enabled with their Segment Select lines high. After reset or power-up the 7704 is enabled. The processor can thereafter choose the segment it wants to address by manipulating the output bits of the 7605.
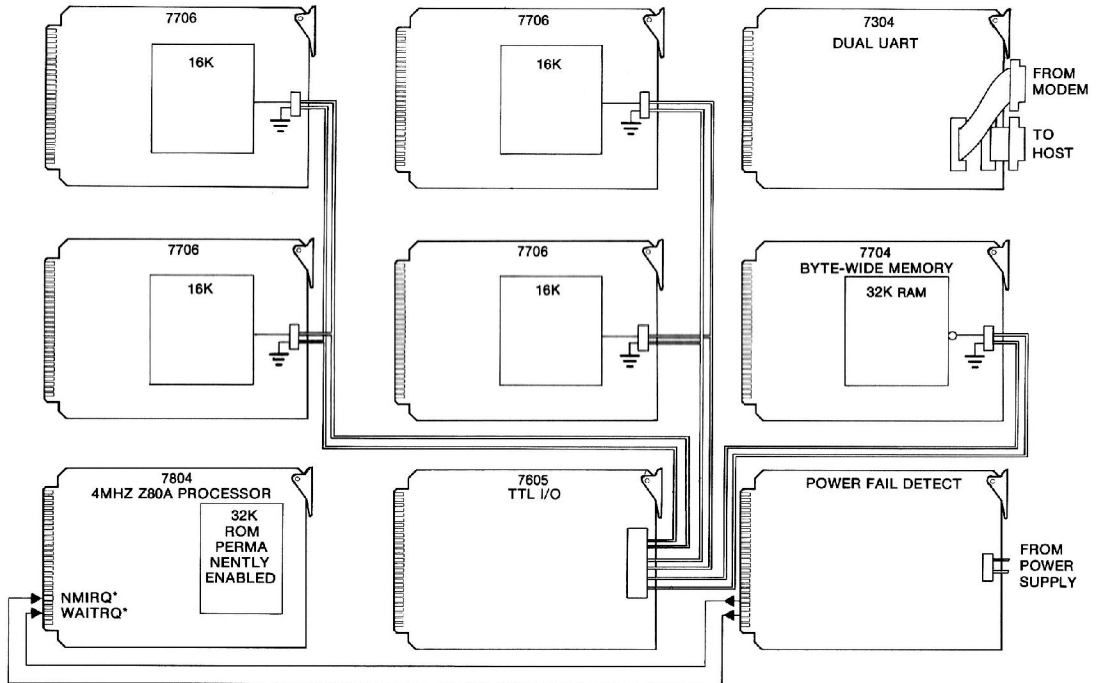

Figure 3-6. 7706 Segment Select Example

SECTION 4
Operating Software

Section 4 is usually reserved for software for operation of an STD Series 7000 card. The 7706 card requires no software.

INTRODUCTION

This section contains information on replacing and handling the lithium battery, return for repair procedures, and warranty information. The schematic and assembly drawings can be found at the back of this manual.

HANDLING THE LITHIUM BATTERY

The battery on the 7706 is a Lithium Bromide battery, a particularly safe form of lithium battery. For handling and disposing the batteries in small quantities, no special guidelines need be followed other than those given below:

- Do not short the battery.
- Do not expose the battery to fire.
- Do not open the battery.
- Do not recharge the battery.
- Do not expose the battery to temperatures greater than 70°C.

CHANGING THE BATTERY

When the battery voltage falls to approximately 2.4V, the Replace Battery LED and Replace Battery* signal will go active. At this point, approximately two weeks of battery life remain.

To change the battery, first read the instructions for handling the lithium battery given in the "Handling of Lithium Battery" section. Then remove the nonconductive protective backing from the 7706.

Caution

Do not set the card down on any conductive material or in any way short the battery.

Next, remove jumper W5, shown in Figure 2-5. Desolder and remove the battery and replace it with a new one. Additional batteries can be purchased from Pro-Log under part number 902663.

Battery current should be checked to ensure that the circuit is working correctly. This may be done by connecting a 100 ohm resistor across the two posts of W5. Measuring the voltage across the resistor, you should read no more than +0.003V, although it may be considerably less. If the reading is greater than this, remove the resistor, leave the battery disconnected, and call Pro-Log Customer Service.

If the reading is correct, remove the resistor and replace jumper W5. Replace the nonconductive protective backing with a new pad. Spare pads can be purchased from Pro-Log under part number 107100.

RETURN FOR REPAIR PROCEDURES

Domestic Customers:

1. Call our factory direct at (408) 372-4593, and ask for CUSTOMER SERVICE.

2. Explain the problem and we may be able to solve it on the phone. If not, we will give you a Customer Return Order (CRO) number.

   Mark the CRO number on the shipping label, packing slip, and other paperwork accompanying the return. We cannot accept returns without a CRO.

3. Please be sure to enclose a packing slip with CRO number, serial number of the equipment, if applicable, and reason for return, with the name and telephone number of the person we should contact (preferably the user), if we have any further questions.

4. Pack the equipment in a solid cardboard box secured with packing material.

CAUTION: Loose MOS integrated circuits, or any product containing CMOS integrated circuits, must be protected from electrostatic discharge during shipment. Use conductive foam pads or conductive plastic bags, and **never** place MOS or CMOS circuitry in contact with Styrofoam materials.

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5. Ship prepaid and insured to:

   Pro-Log Corporation
   2411 Garden Road
   Monterey, California 93940
   Reference CRO #_____

International Customers:

Equipment repair is handled by your local Pro-Log distributor. If you need to contact Pro-Log, the factory can be reached at any time by TWX at 910-360-7082.

Limited Warranty

Limited Warranty: Seller warrants that the articles furnished hereunder are free from defects in material and workmanship and perform to applicable, published Pro-Log specifications for two years from date of shipment. This warranty is in lieu of any other warranty expressed or implied. In no event will Seller be liable for special or consequential damages as a result of any alleged breach of this warranty provision. The liability of Seller hereunder shall be limited to replacing or repairing, at its option, any defective units which are returned F.O.B. Seller's plant. Equipment or parts which have been subject to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation are not covered by warranty. Seller shall have the right of final determination as to the existence and cause of defect. As to items repaired or replaced, the warranty shall continue in effect for the remainder of the warranty period, or for ninety (90) days following date of shipment by Seller or the repaired or replaced part whichever period is longer. No liability is assumed for expendable items such as lamps and fuses. No warranty is made with respect to custom equipment or products produced to Buyer's specifications except as specifically stated in writing by Seller and contained in the contract.

APPENDIX A
Documentation

REFERENCE DRAWINGS

The schematic (Figs. A-1 and A-2) and assembly drawing (Fig. A-3) in the following pages are included in this manual FOR REFERENCE USE ONLY. They may differ in some respects from the card and documentation that the user received from Pro-Log.

The schematic and the assembly drawing shipped by Pro-Log with the card are those from which the card was manufactured.
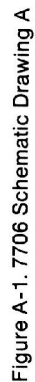
Figure A-1. 7706 Schematic Drawing A

Figure A-2. 7706 Schematic Drawing B

Figure A-3. 7706 Assembly Drawing

USER'S MANUAL

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